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Experiment to evaluate feasibility of utilizing SKYLAB-EREP remote sensing data for tectonic analysis of the Bighorn Mountains region, Wyoming-Montana

Quarterly Progress Report, July 1 - September 30, 1973

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STATUS SUMMARY

Imagery received from SL-2, June, 1973

1. Track 5 - Three Forks, Montana to Crawford, Nebraska

   a. S-190A - Frames 203-222

      1) Pan-X, B&W (S0022) RL-18 0.5-0.6 μm
      2) Pan-X, B&W (S0022) RL-17 0.6-0.7 μm
      3) IR, B&W (EK2424) RL-13 0.7-0.8 μm
      4) IR, B&W (EK2424) RL-14 0.8-0.9 μm

   b. S-190B - Frames 136-158

      High definition aerial B&W (EK3414) 0.5-0.7 μm

   c. S-192

      1) Channel 2 0.46-0.51 μm
      2) Channel 7 0.78-0.88 μm
      3) Channel 11 1.55-1.75 μm

2. Track 19 - Billings, Montana to northwest Nebraska

   a. S-190A - Frames 104-118

      1) Pan-X, B&W (S0022) RL-12 0.5-0.6 μm
      2) Pan-X, B&W (S0022) RL-11 0.6-0.7 μm
      3) IR, B&W (EK2424) RL-7a 0.7-0.8 μm
      4) IR, B&W (EK2424) RL-7b 0.7-0.8 μm
      5) IR, B&W (EK2424) RL-8 0.8-0.9 μm

   b. S-190B - Frames 146-164

      High resolution Color (S0242) RL-81 0.4-0.7 μm

   c. S-192

      1) Channel 2 0.46-0.51 μm
      2) Channel 7 0.78-0.88 μm
      3) Channel 11 1.55-1.75 μm

Coverage conditions

Track 5 - Light snow cover in mountains above 8,000'. Overcast west of Three Forks. Clear to east end of Beartooth Mountains. Overcast over northwest Big Horn basin from Cody north over Pryor Mountains. Rest of Big Horn basin clear. Cumulus over central Bighorn Mountains. Thin cirrus over southeast Bighorns and southwest Powder River basin. Cumulus over south central Powder River basin. Clear over southern end of Black Hills becoming overcast southeast of Chadron, Nebraska.

Track 19 - No snow, Clear except for a few cumulus at northwest end.

ACCOMPLISHMENTS

General

Imagery was examined and evaluated in September. Negatives of selected scenes from the middle of Track 5 were made by the university photo service and 9X9 positives prepared using the department Omega enlarger. Overlays outlining structural features are now being prepared of the basins and Bighorn Mountain flanks (Much of the range is obscured by cumulus clouds and cloud shadows).

Imagery quality and characteristics

1. Track 5

   a. S-190A - Excellent quality overall, complete stereo coverage

      1) Green band - Contrast not as good as in other bands. Cirrus clouds more prominent. However, cloud shadows not as dark such that there is a little better ground visibility.

      2) Red band - By far the best definition and resolution of all bands for both lithology and topography, especially in the basins.

      3) Infrared bands - Cuts through thin cirrus clouds, but shadows from cumulus quite dark and obscure the ground. Water bodies and rivers well defined. The two bands are essentially the same in overall characteristics. Not as good resolution, more grainy than red band. Topography a little better shown in some areas of heavy forest cover.

         An interesting difference between bands can be noted at the northwest end of the track (Frames 203-208) as compared to the rest of the track. At this end, the grassy valleys are much darker on the green and red bands. In these areas, there is much better topographic and structural detail on the infrared photographs. For the rest of the track, the tones in the basins are lighter grays and not markedly different on the various bands except that the basin areas are slightly darker on the infrared, the opposite of the situation above. These differences are interpreted to reflect differences in grass cover. At the northwest end, at this time of year (late spring), the grass is thick and dark green and hence reflects in darker tones on green and red film. In the basins to the southeast, the climate is drier and the grass much thinner, especially in the Big Horn basin. Here grass does not contribute as much to the tonal pattern such that soils and rocks show through better. Higher up in the Bighorn Mountains where the grass is heavier, the appearance is like that of the grassier valleys at the northwest end.

   b. S-190B - Excellent resolution and good stereo coverage. Positive transparencies are a bit dark, particularly in areas of heavy grass and forest cover. By regulating exposure and development times, positive prints prepared from negatives can be varied to bring out more detail in the uplifts or in the basins. These black and whites are about the same as the red band above except for the larger initial scale.

c. S-192 - Imagery shows very little contrast and scan lines interfere with magnified viewing. Only channel 2 provides any significant visual information and this is mainly of clouds and snow at the northwest end.

2. Track 19

a. S-190A

1) Green band - Fairly good detail and contrast

2) Red band - Excellent detail and contrast. Fine definition of cultural features (cultivated fields, towns, roads, strip mines, oil well sites, etc.). Light toned areas of badlands can be mapped in great detail. Other light tones can be correlated to considerable degree with known lithologies (sandstone, gypsum, limstone). Resolution still good at high magnification (30X to 100X)

3) Infrared bands (RL7b too dark) - Best for topography in heavily forested areas of Black Hills and for some drainages in lower areas. Dark shales more visible, but, in general, lithologic and cultural detail not nearly as good as red band. Resolution poor at high magnification.

b. S-190B - Color transparencies show superb detail of cultural features. An inventory of percentage of area of cultivated land could easily be made. Colstrip, Montana strip mines (Frame 150) visible in great detail. Resistant key beds in folds northwest of Billings can be traced easily as can light colored lithologies northwest of Black Hills and in badlands. Red beds (Spearfish formation) quite visible in some places but can be mapped only approximately. Because of the spring season, grassland and forest are not sharply contrasted, but can be distinguished if carefully studied.

c. S-192 - Quality better than Track 5, but still far less useful for photo interpretation than other imagery. Does give a quick overview of coverage. Major drainages and large scale features are discernible.

1) Channel 2 - light tones of badlands best here.

2) Channel 7 - Drainage is light-toned. Best for cultivated areas.

3) Channel 11- Drainage is dark. Best for topography.

Problems

The color infrared and color imagery from SL-2 have not yet been received. We have held back any requests for other data products such as enlargements until all imagery can be examined.

Recommendations

We have requested that the requirement of a minimum 30% acceptable snow cover be removed for SL-4. Experience with winter ERTS scenes indicates that a light to moderate snow-cover can provide worthwhile topographic and structural information. In such a situation, Black and White film in S-190B would probably be a better choice than color or color infrared film.

A request was also made for a U-2 mission completely covering the Black Hills (#72-135). The PI examined a roll of this color film at the University of Wyoming. This mission would provide valuable supplementary support particularly during next summer's field checking.

SUMMARY OF SIGNIFICANT RESULTS

Excellent imagery has been obtained from SL-3 along Track 5 across the Bighorn Mountains and Track 19 across the northern Black Hills. The red band is by far the best of the four black and white films of S-190A. Excellent detail is visible of topography, structure, resistant lithologies, and culture with good resolution obtainable at high magnification (30X). The infrared bands do not have as good resolution and are grainy at high magnification. They are of use as a complement to the red band particularly for relief enhancement in areas of heavy green grass and forest cover.

S-190B high definition black and white is comparable to the red band (S-190A) in detail. Its main advantage is larger initial scale and slightly better resolution. High resolution color transparencies along Track 19 allow detailed delineation of cultivated land and strip mining. A group of folds northwest of Billings stand out clearly. Light colored units in northwestern Black Hills and in the badlands can be mapped in great detail.